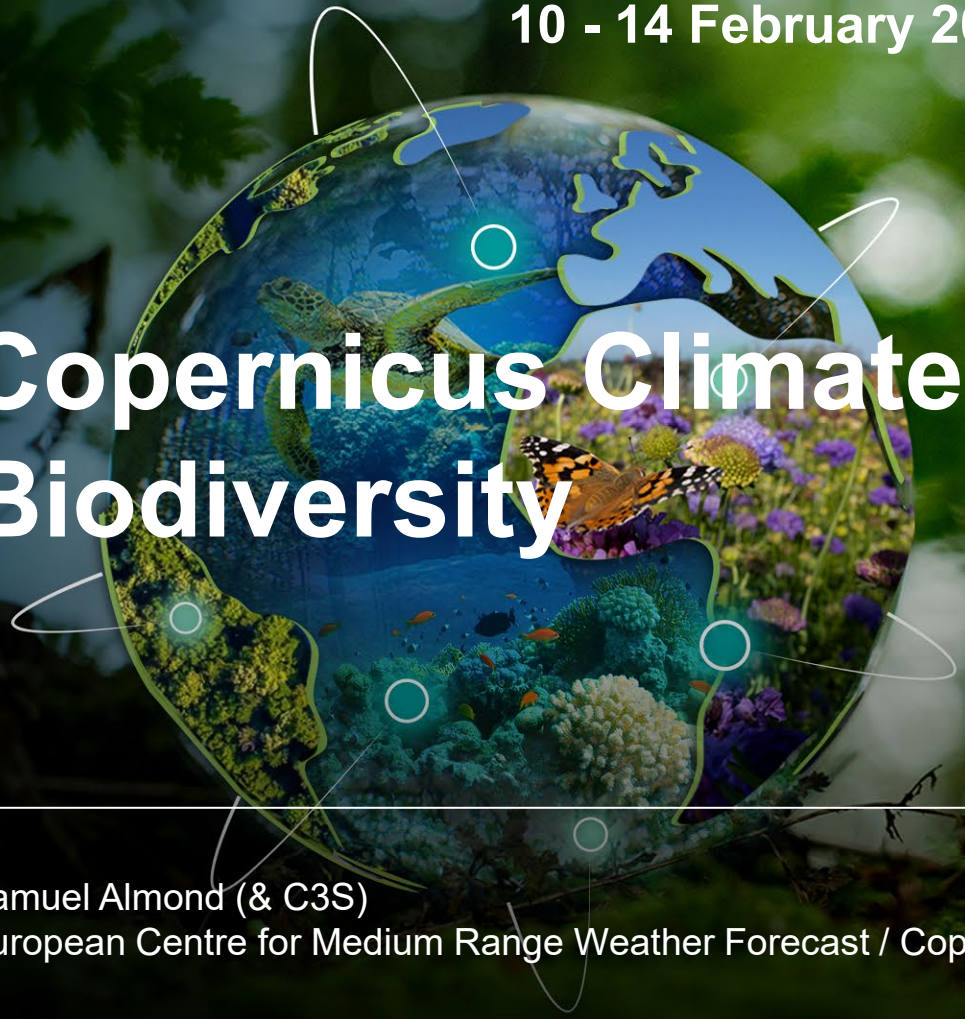
BioSpace25 - Biodiversity insight from Space
10 - 14 February 2025 | ESA-ESRIN | Frascati - Italy



Copernicus Climate Change Service (C3S) for Biodiversity

Samuel Almond (& C3S)
European Centre for Medium Range Weather Forecast / Copernicus Climate Change Service (C3S)

Climate Change

Climate Change & Biodiversity – Context

- Climate change is playing an increasingly important role in the decline of biodiversity.
- Large changes in biodiversity are expected to occur if climate change continues at its current pace
- Climate change has shown to impact the health of ecosystems, influencing shifts in the distribution of plants, pest & disease, animals, and even human settlements.
- Climate change affects:
  - ecosystem dynamics, ecosystem structure, function and health
  - Distribution and abundance of species and habitats
  - Intensity and frequency climatic extremes - fires, storms & periods of drought.
- Ecosystem structure, landscape phenology, community composition, ecosystem function and species populations are all essential biodiversity variables (EBVs) which can be monitored with remote sensing biodiversity products (Skidmore et al. 2021) and Copernicus products
- Copernicus Climate Change Service, and its data can play a key role in adaptive ecosystem management

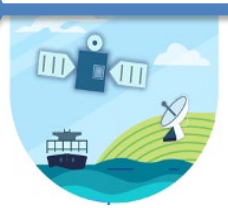
CLIMATE DATA FOR BIODIVERSITY

Climate Change

Past — Present — Possible futures

C3S PRODUCTS

Observations



Reanalysis

Seasonal to decadal predictions

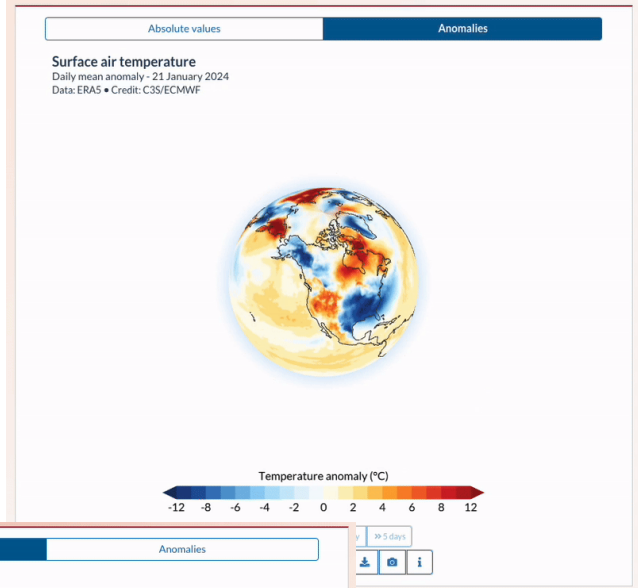
Climate projections

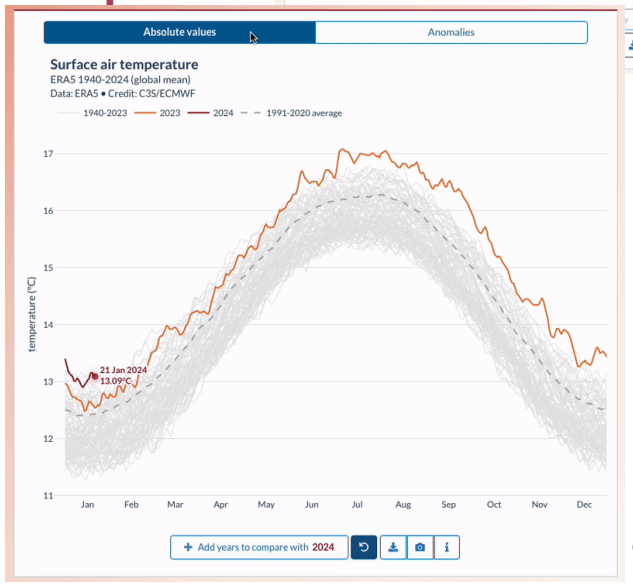
PROGRAMME OF THE EUROPEAN UNION
Copernicus Europe's eyes on Earth
IMPLEMENTED BY ECMWF
Copernicus Europe's eyes on Earth
European Commission
ECMWF

C3S Global reanalysis: ERA5

Climate Change

ERA5: Full-observing-system global reanalysis for the ***atmosphere*, land and *ocean waves***





ERA5 Surface air temperature from Climate Pulse app, including (absolute values and anomalies).

- Most popular dataset in the CDS
- > **100 TB** daily downloads
- No gaps in space/time, integrator of all observations
- Over 100 billion observations used so far
- Hourly snapshot 31 km resolution up to about 80 km height
- Available from **1940 onwards**
- Daily updates 5 days behind real time
- It relies on external gridded products: SST and sea-ice cover; GHGs, aerosols, TSI, (diagnostic) ozone

https://doi.org/10.1002/qj.3803

The ERA5 scientific journal paper (2020) has now topped 10,000 citations

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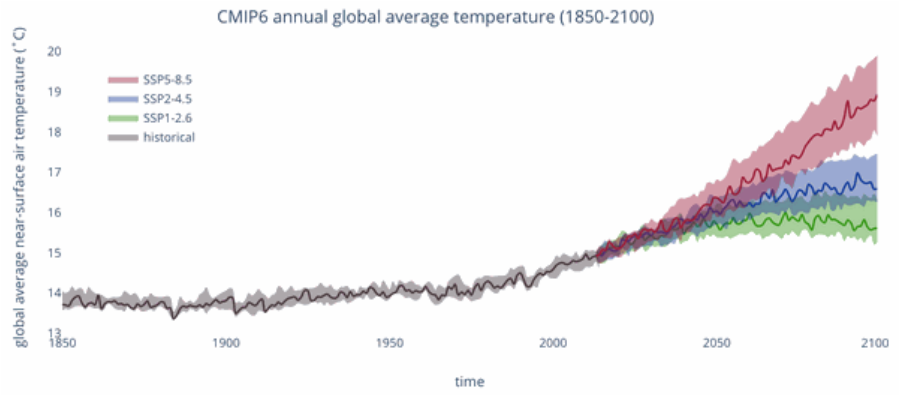
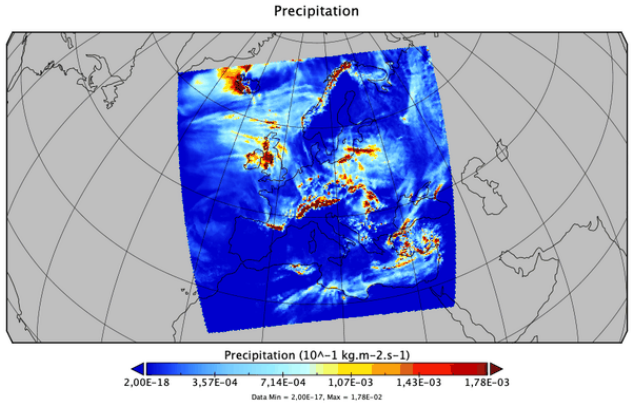
Climate projections: Global, Regional & the IPCC Climate Atlas

Climate Change



CMIP6 annual global temperatures 1850 - 2100

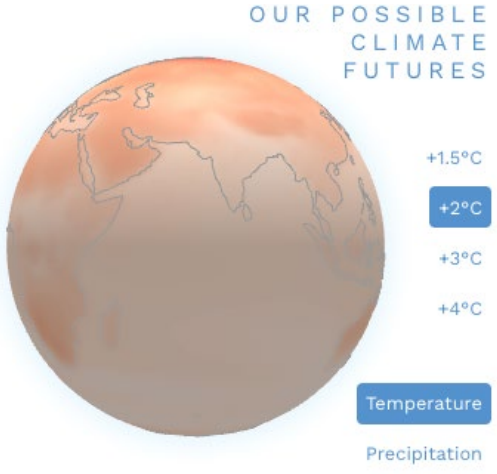


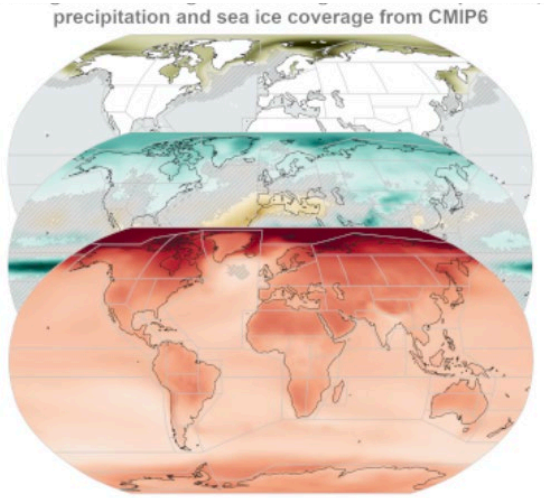
Downscaled Euro-CORDEX projections

Gridded monthly climate projection dataset underpinning the IPCC AR6 Interactive Atlas

Dataset | Global | Atmosphere (surface) | Atmosphere (upper air) | Climate projections

This catalogue entry provides gridded data from global (CMIP5 and CMIP6) and regional (**CORDEX**





A novel tool (data and viewer) for IPCC AR6 for flexible **spatial** and **temporal** analyses of observed and projected climate change information

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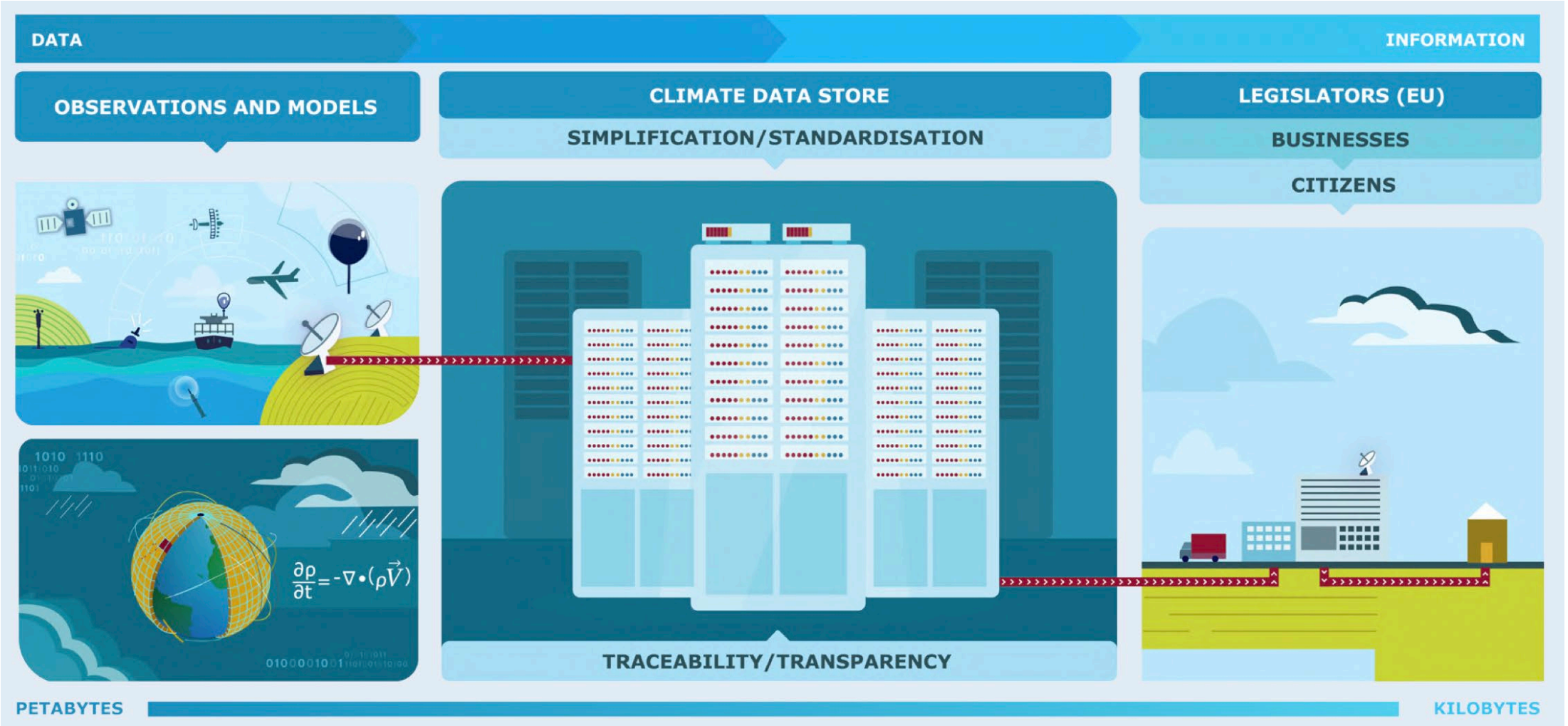
Climate Change

More Than Climate Data..... Climate Information



Typical download: 70 TB /day

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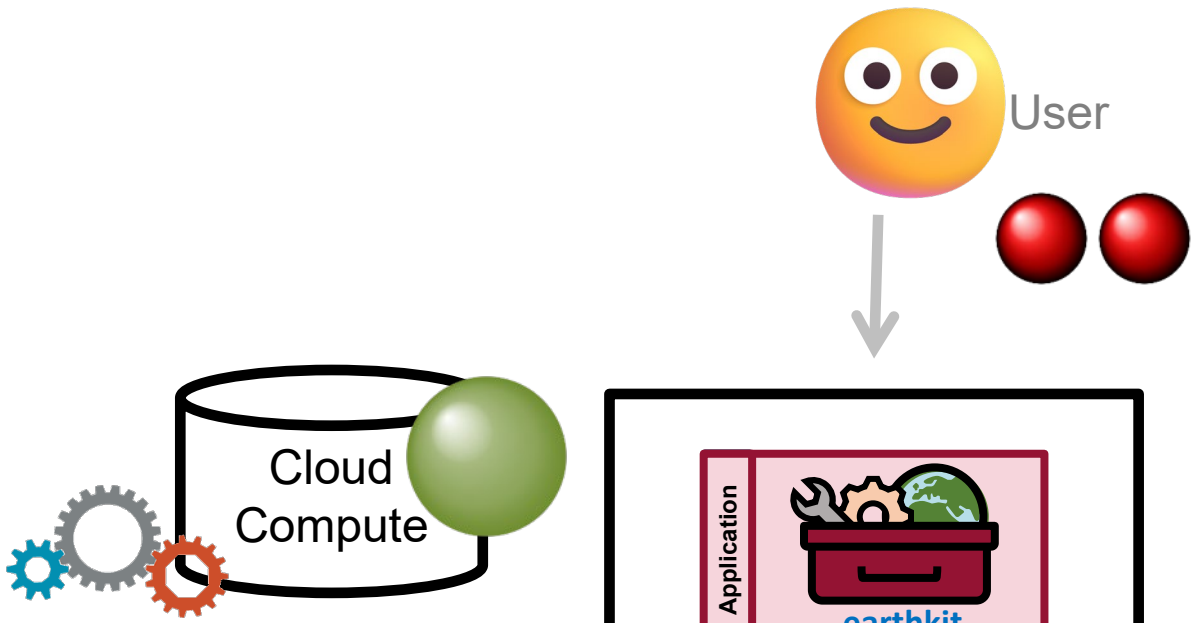
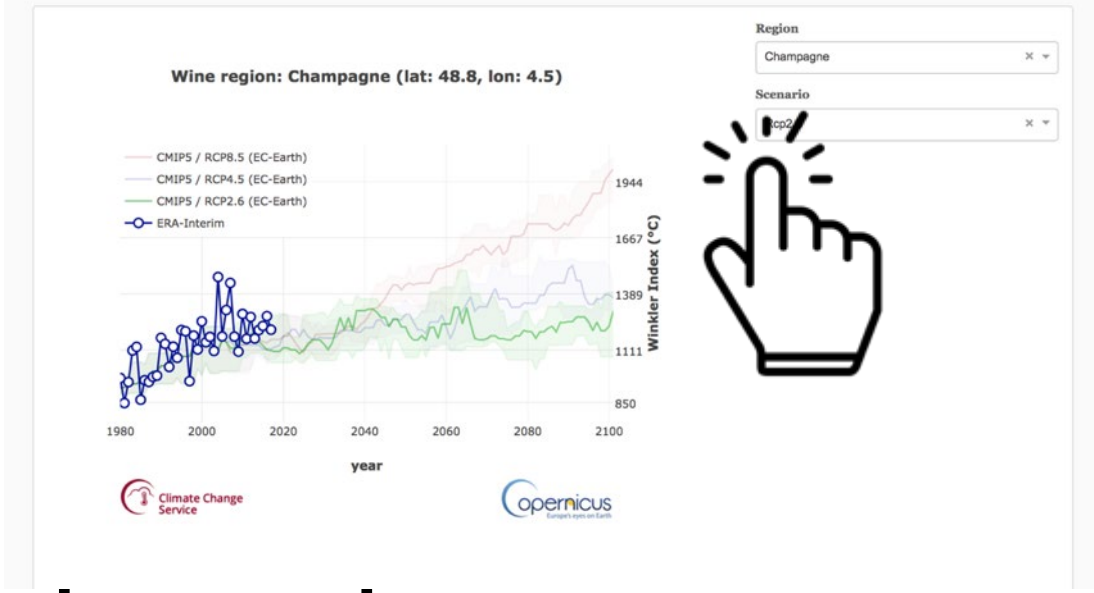
The C3S Application Strategy

Climate Change





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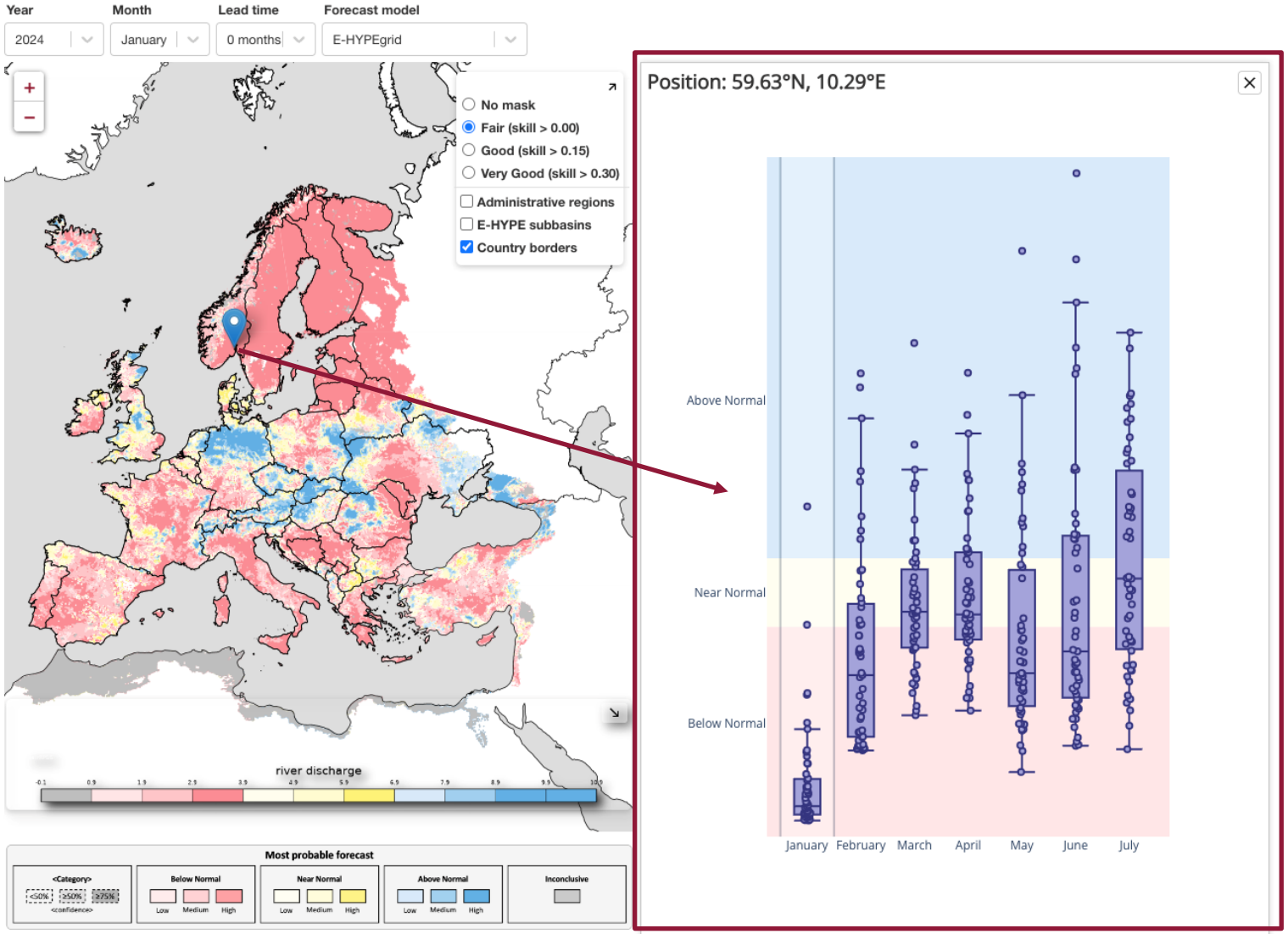
Operational water sector: C3S European hydrology seasonal forecasts

Climate Change



C3S operational multi-model seasonal hydrological prediction service for Europe – *soon to include more climate and hydrological models*

Example: 7-month river discharge forecast from **January 2024** for **River Drammen in Norway**

Below normal river flow expected 4 of the next 7-months

Also provide hydrological model output forced with ensemble climate projections

SMHI

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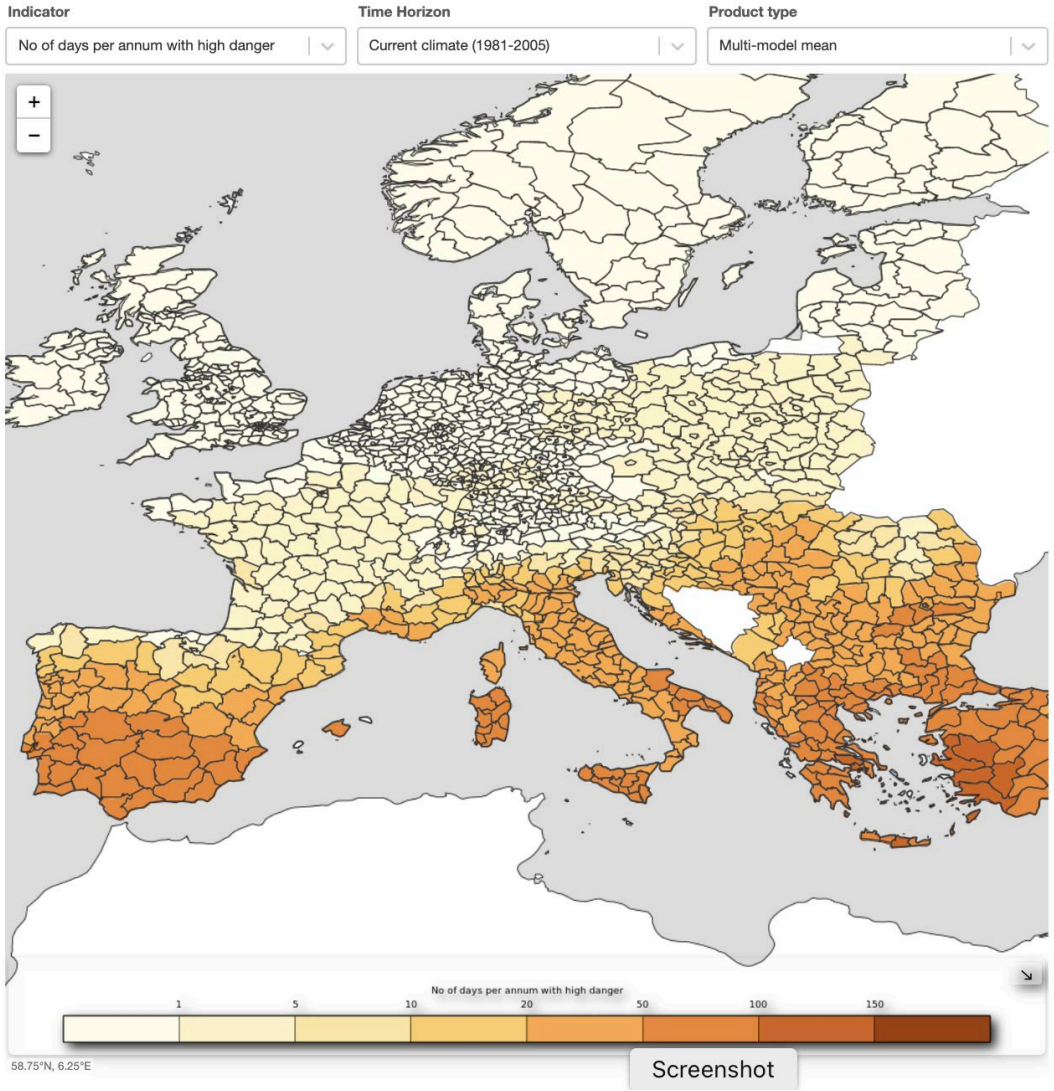
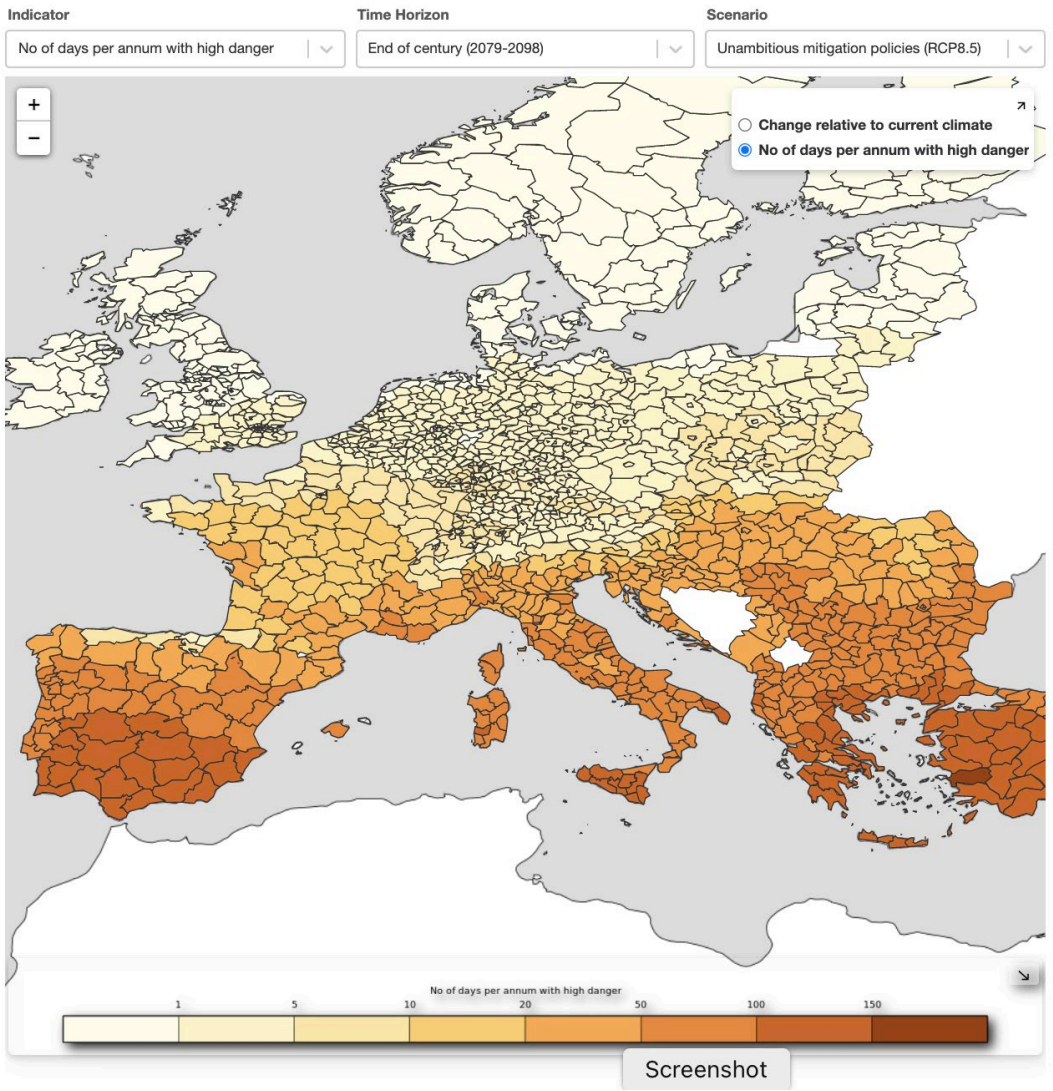
Climate Change

Europes' Evolving Fire Risk



Screenshot



Screenshot

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Climate Change

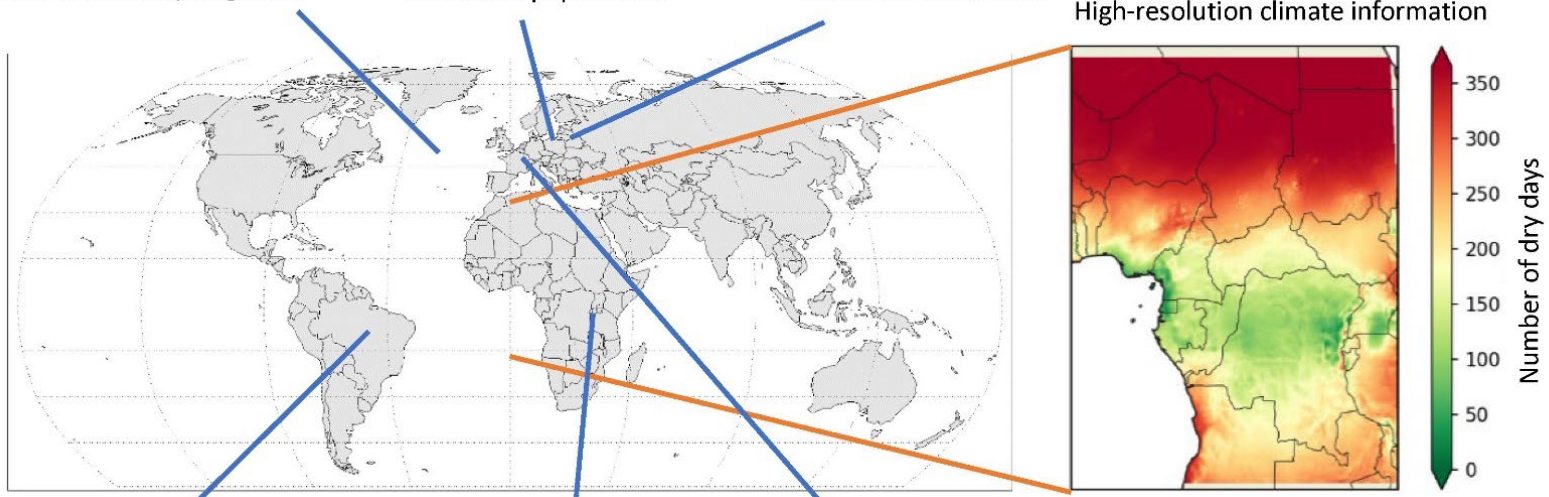
Biodiversity: Demonstrator Service

North Atlantic pelagic fish

Baltic seal populations

Grassland ecosystems

- habitat suitability
- species distribution
- species fitness and reproduction
- ecosystem services



High-resolution climate information

Goldenheaded lion tamarin

Tropical forest biodiversity

Hedgerow ecosystems

- The service provides **two datasets of 79 customized bioclimate indicators** for the past, present and future.
- The indicators are derived climate datasets, i.e. ERA5 for historical reconstruction and CMIP climate projections data
- The service also offers **bioclimate data at a 1km x 1km** grid for selected locations, which responds to **high-resolution** requirements of specific biodiversity challenges

https://climate.copernicus.eu/sites/default/files/2021-07/C3S_Biodiversity_factsheet_20210616.pdf

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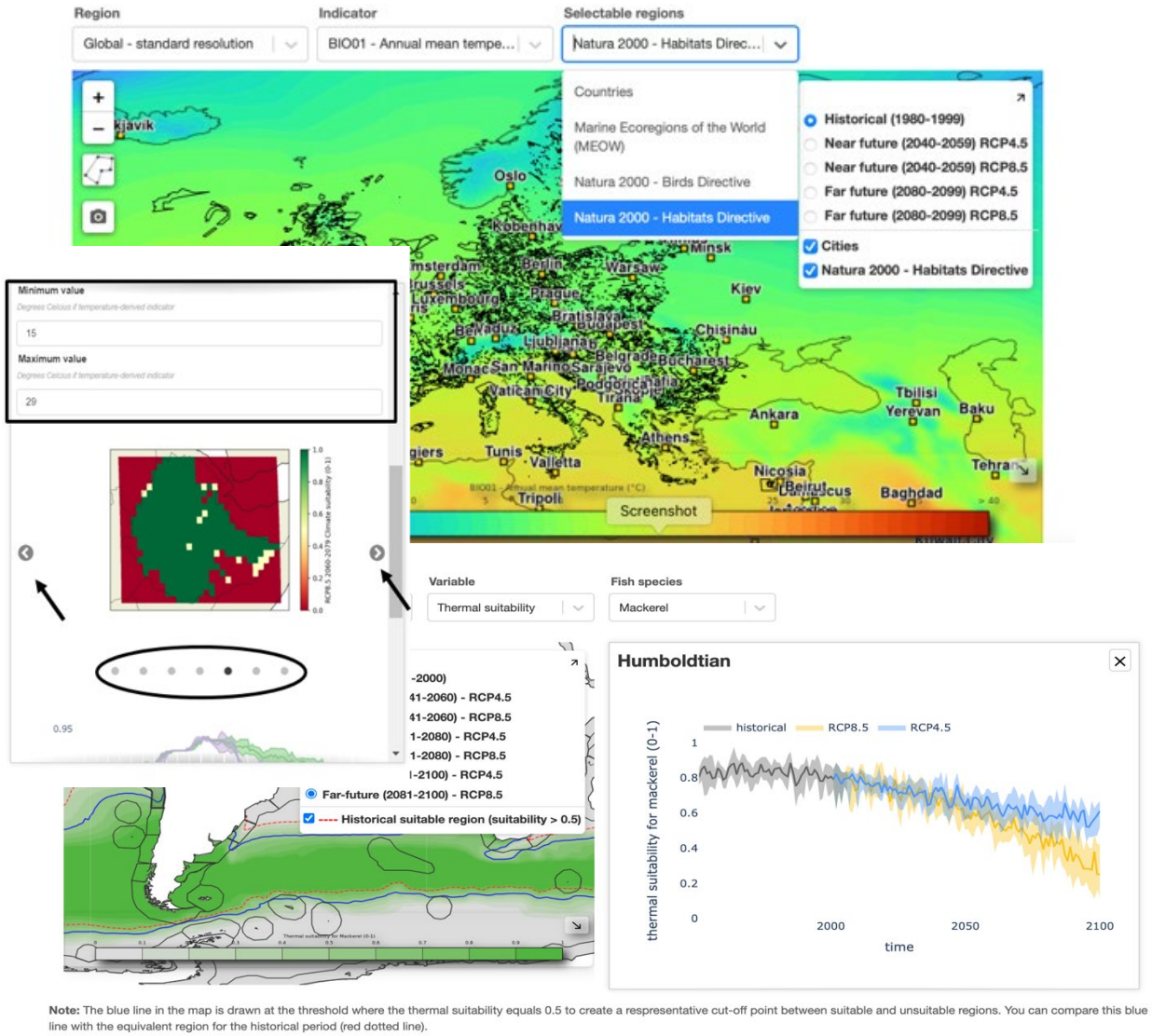
Applications to Support Biodiversity: Assessment of Climatic Suitability

Climate Change

- Interactive applications to visualize and explore 75 key bioclimate indicators (Europe & Global)
- Data developed for biodiversity community in Climate Data Store (CDS)
- Explore per country or by Natura 2000 site*
- User can use a species 'climatic envelope' to help identify when climatic conditions are no longer suitable (leading to stress, dispersal, extinction, …) *
- Dedicated case studies for:
  - European grasslands,
  - Hedge species (flora)
  - Marine fish species & Marine Protected Areas (MPA)

  Exploring the impact of climate suitability on key species & European landscapes



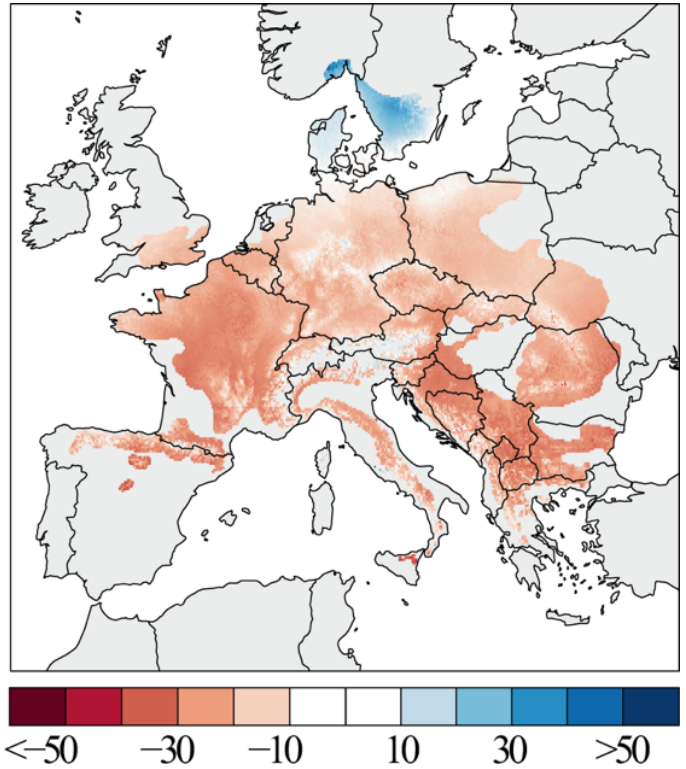
Note: The blue line in the map is drawn at the threshold where the thermal suitability equals 0.5 to create a respresentative cut-off point between suitable and unsuitable regions. You can compare this blue line with the equivalent region for the historical period (red dotted line).

* Application was developed in old infrastructure

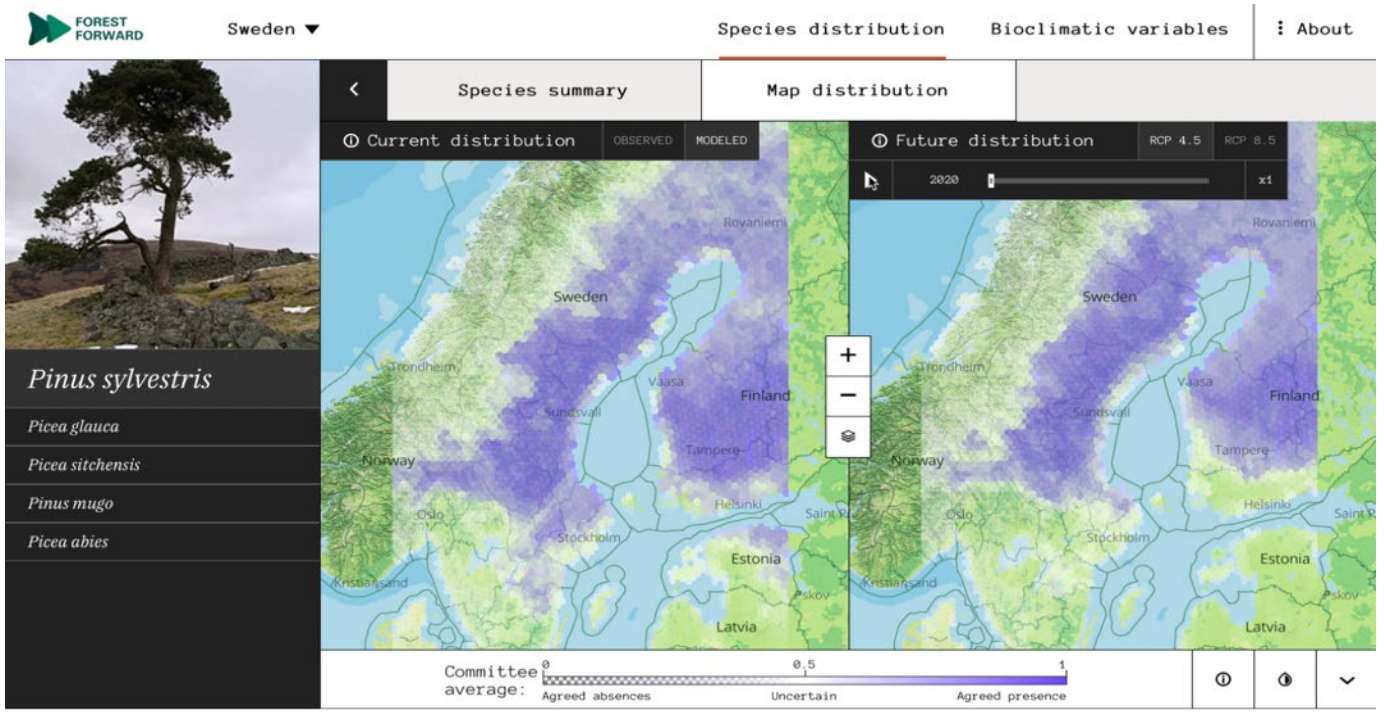
Climate Change

Example Application: Climatic suitability of key European tree species

Climate data can help inform future species distribution and productivity – supporting biodiversity applications



Beech tree growth changes from 1986 to 2016 relative to the 1955–1985 period mean. Source: **Martinez del Castillo et al, 2022.**



C3S data enabled Tecnalia (Spanish SME) to provide distribution maps for key European tree species. Such info can support establishing climate resilient forest (EU Forest strategy 2030)

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Thank you for your attention

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